

Unmanned Aircraft System Operations Manual



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Unmanned Aircraft Systems Operations Manual

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1. Preface

The following procedures are intended to promote safe, efficient and lawful operation of the CAROLINE COUNTY small, unmanned aircraft system (sUAS). Safety, above all else, is the primary concern in each and every operation, regardless of the nature of the mission.

2. Philosophy & Mission Statement

It shall be the mission of those personnel of CAROLINE COUNTY who are trained in the use of unmanned aircraft systems (sUAS), to use this resource to support emergency services missions associated with the Department of Fire – Rescue and Emergency Management under the guidelines outlined in the County’s Certificate of Waiver / Authorization (COA) as issued by the Federal Aviation Administration (FAA). Missions of this nature may include: firefighting incident situational awareness, search and rescue, Amber and Senior Alerts, training programs, damage assessment, and scene documentation. The County may also utilize its sUAS system in support of specific non-emergency government operations under the direction and control of licensed FAA Part 107 pilot. These missions may include: economic development photography and inspection of public buildings.

It shall be the intent of every Pilot in Command to make reasonable efforts to not invade a person's reasonable expectation of privacy when operating the sUAS. When operating the sUAS, CAROLINE COUNTY operators abide by all FAA Regulations for flight and receive the proper authorization for flight.

3. Protection of Rights and Privacy

Pilots in Command and observers ensure the protection of private individuals’ civil rights and reasonable expectations of privacy before deploying the sUAS. Pilots in Command and observers ensure and are held accountable for ensuring that operations of the sUAS intrude to a minimal extent upon the private persons and businesses. To accomplish this primary goal, CAROLINE COUNTY observes the following:

- A. CAROLINE COUNTY does not conduct random surveillance activities. The use of the sUAS is tightly controlled and regulated.
- B. All authorized missions for CAROLINE COUNTY sUAS are for defined specific areas and missions. Missions may include:
 - a. firefighting incident situational awareness
 - b. search and rescue to include Amber and Senior Alerts
 - c. damage assessment
 - d. scene access / egress assessment
 - e. scene documentation
 - f. training programs

- g. any emergency service needs deemed appropriate by the sUAS coordinator or his designee.

CAROLINE COUNTY sUAS operate strictly within the law and regulations. If in doubt, prior to operating the sUAS we ensure that the proper forms and applications are applied for and obtained. All operations are balanced with the need to accomplish the mission while maintaining public privacy and the freedom from intrusion.

UAS-recorded data will not be collected, disseminated or retained solely for the purpose of monitoring activities protected by the U.S. Constitution, such as the First Amendment's protections of religion, speech, press, assembly, and redress of grievances [e.g. protests, demonstrations].

Collections, use dissemination, or retention of UAS-recorded data should not be based solely on individual characteristics (e.g., race, ethnicity, national origin, sexual orientation, gender identity, religion, age, or gender), which is a violation of the law.

4. Transparency

To promote transparency about the Caroline County sUAS programs, while not revealing information that could reasonably be expected to compromise law enforcement or national security, the team will attempt when possible to provide public notice regarding operations. An example of such a public notification document is included in *Appendix 7*. Notifications may be made "door-to-door" or through the County's *CarolineAlert* notification system (text/email/voice).

The team will make available to the public, on an annual basis, a summary of the programs sUAS operations during the previous year. This will include a brief description of types of missions flown.

Information about the County's program as well as changes that would significantly affect privacy, civil rights, or civil liberties will be made available to the public.

5. Data Retention

5.1 Retention

Information collected using sUAS shall not be retained for more than 180 days unless retention of the information is determined to be necessary to an authorized mission of the retaining agency, or is required to be retained for a longer period by any other applicable law or regulation.

Data (photo and video) will be stored on secure local County servers.

Caroline County adheres to the guidelines established by the Library of Virginia, *Records Retention and Disposition Schedule, General Schedule # GS-17 – County and Municipal Governments – Law Enforcement, Fire and Emergency Services*. These policies may be downloaded at http://www.lva.virginia.gov/agencies/records/sched_local/GS-17.pdf.

The Caroline Sheriff's Office will be the custodian of any sUAS photography/video that may be utilized in any criminal investigation.

5.2 Data Privacy to Off Site Servers

Caroline's DJI UAS aircraft utilize systems that transmit mission data via the internet to their company's servers (some outside of the United States). Should the mission parameters be of a nature that any off-site data would reveal information that could reasonably be expected to compromise law enforcement or national security, the Pilot in Command will enable "DJI Privacy Mode" on the flight system. Privacy mode (referred to by DJI as Local Data Mode {LDM}) is enabled in the DJI Pilot app.

6. Definitions

- A. **UNMANNED AIRCRAFT SYSTEM (sUAS):** The preferred industry definition of aircraft designed to navigate in the air without an on-board pilot. The authorization to use sUAS is regulated by the Federal Aviation Administration (FAA).
- B. **CIVIL AIRCRAFT:** all aircraft except a public aircraft.
- C. **LANDING AREA:** a place on land or water, including an airport or intermediate landing field, used, or intended to be used, for the takeoff and landing of aircraft, even when facilities are not provided for sheltering, servicing, or repairing aircraft, or for receiving or discharging passengers or cargo.
- D. **COA:** is an authorization issued by the Air Traffic Organization to a public operator for a specific UA activity. After a complete application is submitted, FAA conducts a comprehensive operational and technical review. If necessary, provisions or limitations may be imposed as part of the approval to ensure the UA can operate safely with other airspace users. In most cases, FAA will provide a formal response within 60 days from the time a completed application is submitted.)
- E. **PILOT IN COMMAND (PIC):** The person who has final authority and responsibility for the operation and safety of flight, has been designated as pilot in command before or during the flight, and holds the appropriate category, class, and type rating, if appropriate, for the conduct of the flight. The pilot in command position may rotate duties as necessary with equally qualified pilots. The individual designated as PIC may change during flight. All Pilots in Command will be required

- to be certified by the Federal Aviation Administration (FAA) under 14 CFR Part 107 and possess a Remote Pilot Airman Certificate.
- F. **VISUAL LINE-OF-SIGHT:** A method of control and collision avoidance that refers to the pilot or observer directly viewing the unmanned aircraft with human eyesight. Corrective lenses (spectacles or contact lenses) may be used by the pilot or visual observer.
 - G. **OBSERVER:** A trained person who assists the unmanned aircraft pilot in the duties associated with collision avoidance. This includes, but is not limited to, avoidance of other traffic, clouds, obstructions and terrain.
 - H. **PUBLIC AIRCRAFT:** An aircraft operated by a public user which is intrinsically governmental in nature (i.e. federal, state, and local agencies). Examples of public entities in Caroline County are the Caroline County Department of Fire – Rescue and Emergency Management, Sheriff's Office, other local, state, and federal government agencies; and state universities. Refer to 14 CFR 1.1, General Definitions, for a complete definition of a public aircraft.

7. Administration

7.1 Operations Manual

1. The policies and procedures contained in this manual are issued by CAROLINE COUNTY.
2. This manual is not intended to be all-inclusive, but as a supplement to other County guidelines, Commonwealth of Virginia laws, Federal Aviation Administration regulations, pre-flight safety checklists, aircraft manufacturers' approved flight manual, etc.
3. This manual has been written to address sUAS operations as they existed when it was drafted. Equipment, personnel, environment (internal and external), etc., change over time. The management of change involves a systematic approach to monitoring organizational change and is a critical part of the risk management process. Given this, it is essential that this manual be continually updated as necessary. The entire manual must be reviewed, at a minimum, annually to assure it is up to date. Any changes to the manual will be communicated as currently dictated by policy.
4. A copy of the manual (electronic and/or paper) is issued to every person having sUAS responsibilities.

7.2 Organization

1. The sUAS unit is comprised of those personnel approved by CAROLINE COUNTY. It includes operators, observers and others deemed necessary as part of the sUAS crew.

2. Assignment to the sUAS flight crew is accomplished following careful selection and training by CAROLINE COUNTY.

7.3 Personnel

1. Pilot-in-command (PIC):
 - a. Responsible for the overall direction and performance of the UAS unit and exercises command and control over it.
 - b. The PIC will check the sUAS before and after missions to ensure the UAS is airworthy.
2. UAS Coordinator:
 - a. Maintaining all training, flight records for each operator and observer.
 - b. Maintain all service/maintenance records for the sUAS and equipment.
 - c. Maintain contact with the FAA and regulations as they change.
3. Operators:
 - a. An operator's primary duty is the safe and effective operation of the sUAS in accordance with the manufacturer's' approved flight manual, FAA regulations and CAROLINE COUNTY policy and procedures.
 - b. Operators may be temporarily removed from flight status at any time by the UAS Coordinator for reasons including performance, proficiency, physical condition, etc. Should this become necessary, the operator will be notified verbally and in writing of the reason, further action to be taken and expected duration of such removal.
 - c. The UAS Coordinator will maintain a file for each operator which will include copies of training records, flight incidents, etc. This file is reviewed in accordance with current CAROLINE COUNTY policy and procedures.
4. Observers:
 - a. Observers must have been provided with sufficient training to communicate clearly to the operator any turning instructions required to stay clear of conflicting traffic and obstacles.
 - b. An observer's primary duty is to operate the sUAS's equipment including cameras, thermal imaging camera, radio communications with other crew members and property owners as well as be an observer for anything that may affect the operator's primary duty.
 - c. The UAS Coordinator maintains a file for each observer, which includes copies of training records, UAV incidents, etc.

7.4 Storage / Facilities

1. sUAS operations are housed and maintained by the Caroline County Department of Fire – Rescue and Emergency Management. sUAS equipment will be located behind a secured door, gate or by other means to ensure the security of the equipment.

2. Only the sUAS flight crew and designated individuals will have access to secured sUAS location(s).
3. Personnel must not leave sUAS equipment unsecured.
4. All personnel are equally responsible for maintaining the storage location in a neat, clean and orderly fashion.

7.5 Scheduling

1. To facilitate the broad use of the sUAS, it shall be made available to all sUAS flight crew members.
2. To maintain a level of proficiency with the sUAS, operators are required, as part of their acceptance into the sUAS flight crew, to attend all required training. Training is coordinated through the sUAS flight crew and announced in advance for scheduling purposes.

7.6 Miscellaneous

1. Inquiries from the news media must be forwarded to the CAROLINE COUNTY Administrator or Fire – EMS Chief (or their designee). Operators/Observers shall follow currently established County policy regarding interactions and inquiries from the media.
2. Requests for support from third-parties will be responded to by the sUAS coordinator. Should the request involve an immediate threat to life, or property, the operator is authorized to accept or decline the request. Proper policy and procedure, as well as FAA regulations must be followed when accepting mutual aid support for the sUAS.
3. Complaints or inquiries regarding sUAS operations must be referred to the sUAS coordinator.

8. Audits / Oversight

The Fire – EMS Chief, or his designee, will provide oversight of the team operations and appoint an UAS Team Coordinator. This oversight will include audits or assessments of safety policies, regulations, and practices.

9. Safety

9.1 Safety Policy

1. CAROLINE COUNTY is committed to having a safe and healthy workplace, including:

- a. The ongoing pursuit of an accident free workplace, including no harm to people, no damage to equipment, the environment and property.
 - b. A culture of open reporting of all safety hazards in which management will not initiate disciplinary action against any personnel who, in good faith, disclose a hazard or safety occurrence due to unintentional conduct.
 - c. Support for safety training and awareness programs.
 - d. Conducting regular audits of safety policies, procedures and practices.
 - e. Monitoring the sUAS community to ensure best safety practices are incorporated into the organization.
2. It is the duty of every member within the sUAS flight crew to contribute to the goal of continued safe operations. This contribution comes in many forms and includes always operating in the safest manner practicable and never taking unnecessary risks. Any safety hazard, whether procedural, operational, or maintenance related must be identified as soon as possible after, if not before, an incident occurs. Any suggestions in the interest of safety should be made to the sUAS Coordinator.
3. If any member observes, or has knowledge of an unsafe or dangerous act committed by another member, the sUAS coordinator is to be notified immediately so that corrective action may be taken.

9.2 Operational Hazard and Occurrence Report (OHOR) and Investigations

1. Occurrences are unplanned safety related events, including accidents and incidents that could impact safety. A hazard is something that has the potential to cause harm. The systematic identification and control of all major hazards is foundational to safety.
2. The OHOR concept provides a mechanism to report hazards and occurrences, real and perceived, to those responsible for sUAS operations.
3. There is no specific format for the OHOR as the information provided is what is important, not the format and should be used without hesitation to report any anticipated, current, or experienced safety hazard, or occurrence. Further, the OHOR can be submitted anonymously, and to whatever level in the chain of command, to get the matter proper attention, without fear of reprisal.
4. Written memorandums fully explaining the problem will be given to the sUAS coordinator for investigation.
5. Every hazard and/or occurrence is investigated, with the results and corrective action taken communicated to all members. The investigation will be conducted by the sUAS coordinator or any other member of the County who has the technical skill necessary to do it. The services of an independent subject matter expert may be necessary in some cases to assure a thorough and complete investigation.
6. Hazards requiring immediate attention will be brought to the attention of the sUAS coordinator, verbally, without delay.

7. ALL MEMBERS ARE AUTHORIZED TO TAKE ACTION TO CORRECT A HAZARD if in that member's opinion delay will result in accident or injury. The sUAS coordinator will be notified immediately in such situations.

9.3 Safety Officer - Operator/Observer/Coordinator

1. In regards to safety, all members of the sUAS flight crew are responsible for the following:
 - a. Ensuring all flight operations personnel understand applicable regulatory requirements, standards and organizational safety policies and procedures.
 - b. Observe and control safety systems by monitoring all operations.
 - c. Review standards and the practices of County personnel as they impact operational safety.
 - d. Communicate all reported safety related problems and the corrective action taken. If there were any in-flight problems (or learned experiences), the proper procedures for handling that problem should be discussed.
 - e. Copy and circulate pertinent safety information.
 - f. Copy and circulate emergency safety bulletins.
 - g. Place any electronic copies of safety information or bulletins in a conspicuous location for all employees to access.
 - h. It is emphasized again that safety is the responsibility of ALL members of the sUAS unit.

9.4 Safety Training

1. All members shall receive training in the following subjects prior to operating the sUAS as a released PIC:
 - a. County policy
 - b. sUAS member's role in safety
 - c. Emergency procedures

9.5 Medical Factors

1. Operator and Observers shall only deploy the sUAS when rested and emotionally prepared for the tasks at hand.
2. Physical illness, exhaustion, emotional problems, etc., seriously impair judgment, memory and alertness. The safest rule is not to act as an operator or observer when suffering from any of the above. Members are expected to "stand down" when these problems could reasonably be expected to affect their ability to perform flight duties.
3. A self-assessment of physical condition shall be made by all members during pre-flight activities.

4. Performance can be seriously hampered by prescription and over-the-counter drugs. The sUAS Coordinator must be advised anytime such drugs are being taken. If it is determined that the medication being taken could hamper an operator or observer, that member shall be prohibited from the deployment or exercise.
5. No member shall act as an operator or observer within eight hours after consumption of any alcoholic beverage, while under the influence of alcohol, or while having an alcohol concentration of 0.04 (FAR 91.17)

10. Training

10.1 Objective

1. The key to continued safe operations is by maintaining a professional level of competency. The first step in this process is establishing minimum qualifications for selecting members, and the second step involves training those personnel.

10.2 Instructors

1. Duties of instructing new members shall fall upon those who have the most flight time and knowledge of sUAS operations. Instructors are designated by those within the unit and approved by the sUAS Coordinator.

10.3 Training Plans

1. The approved training plan is developed by the sUAS coordinator.
2. All deployments or exercises are documented and count toward a member's training.
3. It is the member's responsibility to verify their training file contains all pertinent information.

10.4 Initial Training

1. Observers and Operators must have completed sufficient training to communicate to the pilot any instructions required to remain clear of conflicting traffic.
2. All Remote Pilots in Command will be required to be certified by the Federal Aviation Administration (FAA) under 14 CFR Part 107 and possess a Remote Pilot Airman Certificate.
3. In conjunction with fulfilling all training requirements for operator/observer duties, the new member must also become familiar with sUAS operations, the aircraft and its equipment.
4. Any new member who fails to successfully complete the initial training may be denied as a member of the sUAS flight crew.

5. Before a member can fly as an operator, they must complete a period of flight training with the sUAS instructors to show proficiency of the flight training exercise and the airframe (typically an 8 hour day). This must be accomplished to show their ability and knowledge of the sUAS.

10.5 Recurrent Training

1. All members within the unit shall maintain proficiency in their operator/observer abilities.
2. Recurrent training is not limited to actual operating/observer skills but includes knowledge of all pertinent sUAS/aviation matters.
3. Failure to prove proficiency can result in removal from sUAS responsibilities.

10.6 Miscellaneous

1. Depending on the nature of the training request, all efforts are made to accommodate the hours of training so as little impact is made to staffing levels.
2. All requests for training shall be approved through the member's chain of command and the UAS Coordinator and documented as required.
3. Members are encouraged to attend, and forward information on FAA sponsored safety seminars.

11. General Operating Procedures

11.1 Request for sUAS Support

1. Requests for sUAS support shall be made through the Caroline Emergency Communications Center or the sUAS coordinator who has the most current list of Pilot in Commands and observers to contact.
2. Requests for sUAS support can be made at any time during the day or night. Caroline's ECC has access to a specific sUAS team group in the Caroline Alert system. This system may be used to alert team members as needed.

11.2 Call-out Procedure

1. The Caroline Emergency Communications Center will screen all initial requests to use a sUAS.
2. The Emergency Communications Center will notify the sUAS Coordinator (or their designee), who will vet the mission.
3. The sUAS coordinator will then contact the PIC to request the deployment of the sUAS.

4. The sUAS Coordinator will also contact the sUAS flight crew who will screen the request using the following factors:
 - a. Is the proposed use of sUAS within the capabilities of the sUAS equipment and personnel to perform?
 - b. Does the proposed use of the sUAS fall within the FAA and department policies and regulations for sUAS usage?
 - c. Can the sUAS be deployed safely given current weather conditions?
 - d. If the sUAS deployment requires a warrant, has one been requested and approved?
 - e. Are sufficient trained and qualified personnel available to safely operate the sUAS?
5. The sUAS flight crew will either accept or decline the request for sUAS support. If the request is denied, the sUAS flight crew will provide a reason for declining the support request to the sUAS Coordinator who will provide the requestor this information along with the reason for declining. If the sUAS Coordinator accepts the support request, they will contact a Pilot in Command who will be provided all available mission information.
6. The Pilot in Command will contact a certified observer from the list of available trained observers. The Pilot in Command is responsible for transporting the sUAS and all required equipment to the scene. Upon arriving at the requested location the Pilot in Command will contact the requestor to check in and receive a briefing on the mission requested. The Pilot in Command will make an on scene determination of the ability of the sUAS to perform the requested mission safely and within County and FAA policies and procedures.
7. If the Pilot in Command determines that the use of the sUAS would violate County policy or directives then the Pilot in Command will inform the requestor of the potential conflict along with recommendations for modifying the requested mission to conform to policies and procedures. As this is a change from the original approved mission the Pilot in Command will contact the sUAS coordinator for direction on how to proceed. As soon as possible after the completion of the mission, the Pilot in Command will make a full report of the circumstances and their concern through the sUAS coordinator.
8. The Pilot in Command will have sole discretion for declaring a safety issue or a violation of FAA rules. If the Pilot in Command determines that a requested mission would violate FAA rules or endanger persons or property, then the Pilot in Command will respectfully inform the requestor of the reasons for refusing to operate the sUAS and contact the sUAS coordinator immediately. The sUAS will not be flown in this circumstance and the authority of the Pilot in Command is absolute.
9. If the Pilot in Command determines that the requested mission will potentially damage the sUAS or its associated equipment the Pilot in Command will inform the requestor of their concerns. The Pilot in Command will fully document and send a report to the sUAS coordinator.

11.3 Deployment Priorities

1. The sUAS shall not be used for the purpose of random surveillance.
2. If multiple requests for sUAS support are received simultaneously, they shall be prioritized.
3. In general terms, requests for sUAS support are prioritized as:
 - a. Life Safety
 - b. Incident Stabilization
 - c. Property Conservation
 - d. Non-Emergency Departmental Missions

11.4 Flight Boundaries

1. Although there may be requests for sUAS support in restricted airspace, FAA regulations for sUAS restrict sUAS deployment inside restricted airspace.
2. At no time shall sUAS support be granted inside restricted airspace without first obtaining permission from an FAA authorized administrator and approval by local authorities.
3. Maximum altitude shall not be more than 400' AGL or, when within 400' radius of an obstacle, 400' above the uppermost point of the obstacle.
*IAW 14 CFR Part 107 or Public Agency Certificate of Authorization(s)
4. The operator will ensure that only authorized persons will be allowed within the designated distance of the flight operation, and this area may be reduced depending on the safety determination.

11.5 Minimum Personnel Requirements

1. Due to the nature of the mission, the minimum personnel required on ALL missions will be an operator and observer. Under no circumstances will an operator attempt to complete a deployment alone.
2. Although training is not considered a mission, an observer shall be used.

11.6 Personnel Responsibilities for Deployments

1. Operator
 - a. The operator is directly responsible for, and is the final authority over the actual operation of the sUAS.
 - b. Operators have absolute authority to reject a flight based on personnel safety or violation of FAA regulations. No member of CAROLINE COUNTY, regardless of status, shall order an operator to make a flight when, in the opinion of the operator, it poses a risk to personnel or is in violation of FAA regulations.

- c. Operators are responsible for compliance with this manual, County policy and procedure and FAA regulations.
 - d. The operator's main duty during the deployment of the sUAS is to operate the sUAS safely while accomplishing the goals of the deployment.
 - e. Operators shall see-and-avoid any obstacle that will lessen safety during the mission.
 - f. Operators shall be responsive to the requests of the observer in order to accomplish the deployment.
 - g. Operators shall be responsible for documentation for mission training and updating of flight books.
2. Observer
- a. Observers shall see-and-avoid any obstacle that will lessen safety during the mission.
 - b. Observers are responsible for the operational aspect of the deployment.
 - c. Observers shall operate any attachments to the sUAS, allowing the operator to maintain complete focus on the operation of the sUAS.
 - d. Observers shall remain alert for suspicious persons or activities on the ground and coordinate response by other sUAS flight crew members.
 - e. Observers shall assist the operator in the main objective of safe operations of the sUAS.
 - f. Observers shall be responsible for documentation for mission training and updating of flight books.

11.7 Personal Equipment

1. Although there is no specific uniform for the sUAS unit or required for proper operation of the sUAS, the operator/observer should take necessary measures to deploy in a professional matter, wear Hi-Visible vests when appropriate, and take into consideration that all deployments are subject to media requests.
2. Operators/Observers will take into consideration the current weather conditions when planning to deploy, and wear appropriate clothing to deploy comfortably.
3. There are no documented issues with the use of the radio or cellular phones during the deployment of the sUAS, but the operator/observer should at all times take into consideration safe operation of the sUAS when using a radio or another device.

12. Emergency Procedures

12.1 Emergency Loss of Signal Procedures

General - Caroline's sUAS will be configured for Failsafe Operations in the event of a "loss of signal. In this operations, the aircraft will initiate a Return to Home (RTH) process after

recording a loss of signal for three seconds. Before launch, operators should verify that the Failsafe RTH feature is enabled and adjust the RTH attitude as necessary. Operators should refer to the manufacturer's aircraft users guide for additional information.

Emergency Procedures

1. Personnel flying the sUAS will be trained that in any emergency situation, the safety of persons on the ground and in the air is number one. The following are emergency procedures and each will be documented with an emergency checklist for crew to review.
2. **Fire:** sUAS will be flown away from people and property until a safe landing location can be found. A fire extinguisher and first aid kit will be located at the mission site.
3. **Loss of Link:** Onboard system will execute lost link protocol by either landing immediately or returning to launch point and land.
4. **Loss of Line of Sight:** In the event that both crewmembers lose sight of the aircraft, the pilot will initiate a Go-Home on the remote control. The Go-Home protocol is identical to the Loss of Link protocol. Once visual contact with the aircraft is re-established the pilot will take-back the aircraft using the remote control.
5. **Loss of Propulsion:** During a propulsion failure, sUAS coordinated flight cannot be maintained effectively. An announcement will be made to all personnel on scene advising them of the emergency. If the aircraft fails to successfully land at a predetermined location, a recovery operation will be initiated.
6. In the unlikely event of an emergency involving the aircraft and person(s) on the ground, the flight crew (PIC and Observer) shall maintain a list of applicable numbers (EMS, Dispatch) for emergency contact.

12.2 Loss of Communications between Observer & PIC

The PIC and Observer will be co-located during operations and communications will be through direct communication. However, if the observer and the PIC are co-located where verbal communication is not possible, the following communication tools will be utilized:

- Hand held radio
- Voice actuated headsets
- Cellular phone
- Hand Signals (may be used solely or in conjunction with the communication equipment)
- If communication is lost and cannot be re-established the sUAS will immediately land.

13. Pre-Flight/Post-Flight Actions

13.1 Inspections

1. Operators/Observers are both responsible for a thorough preflight inspection of the sUAS.
2. Before and after each deployment (whether a mission or training), the operator and observer shall conduct a thorough inspection of the sUAS in accordance with the instructions contained in the manufacture's user's manual.
3. Any issues found that will put in jeopardy the safe operation of the sUAS shall be documented and resolved immediately prior to flight.
4. It has been recognized that the use of a checklist is a significant method to combat sUAS accidents. A Caroline specific pre-flight checklist is contained with each sUAS Base Station and is utilized prior to each flight.
5. Any issues / discrepancies with physical equipment that cannot be resolved on-site, and which have an impact on safety or the mission, will override the deployment. These issues will be resolved before flight.

13.2 Weather

1. Before each deployment the operator/observer will ensure that he/she gathers enough information to make themselves familiar with the weather situation existing throughout the area of deployment. The operator shall utilize FAA approved weather resources to obtain the latest and most current weather conditions.
2. An anemometer should be utilized in order to better estimate the wind speed and determine if it is within the capabilities of the airframe being flown.
3. Operators/Observers should use the Beaufort Scale when making deployment decisions in regards to wind conditions.
4. The weather conditions reported for the operation shall be recorded in the pre-flight checklist.
5. The operator shall ensure that the flight will occur within FAA VFR weather requirements.

13.3 Documentation

1. Inspection and weather will be documented prior to flight within the log book.
2. After each flight, the operator will complete a statement documenting the sUAS operations.

13.4 Planning

1. The operator/observer shall familiarize themselves with all available information concerning the deployment including, but not limited to, the weather conditions, hazards, description of the incident, deployment goals, etc.
2. Operators will ensure that the location for take-off and emergency landing is adequate for a safe deployment.
 - a. The take-off/landing area should be clearly marked and identifiable with short cones.
 - b. At least one emergency landing area should be identified per deployment.
3. Operators will ensure that they are aware of their surroundings in the event that an emergency landing is necessary. This includes the ability to recover the sUAS.

13.5 Checklists

1. Operators shall utilize pre-flight checklists to ensure the highest level of safety for deployment.
2. Prior to flight, the flight log shall be initiated.

13.6 Maintenance

1. Although there are few parts on the sUAS that need servicing, it is necessary that the manufacturer's maintenance schedule is followed and properly documented.
2. Any issues that arise during maintenance that cannot be resolved by routine methods shall be forwarded to the manufacturer for further technical support.














13.7 Other

1. Operators/Observers will ensure that no items are attached to the sUAS prior to flight that are not required for safe operation and to complete the mission goal.

Appendix 1

Beaufort Wind Scale

Beaufort Scale

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

DJI Phantom 4 maximum wind velocity for flight:
20m/s or 22 mph or 19.4 knots or Beaufort #5.

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Appendix 2

Area Aviation Contacts Impacting Caroline County

Fort AP Hill
Aviation Unit
804-633-8272 or 804-633-8713

Note – Aviation Unit is staffed when training is active. If unit is unmanned, contact AP Hill Range Control unit at 804-633-8157 or 804-633-8224

Monitor – 126.200 MHz

Woodford Airpark (Private) (20VA)
Bull Church Rd
Woodford, VA 22580
804-448-0982
Monitor – UNICOM - 122.800 MHz

Shannon (EZF) Airport
3380 Shannon Airport Circle
Fredericksburg, VA 22408
540-373-4431
540-979-4431
Monitor – CTAF/UNICOM – 122.800 MHz

Appendix 3

Sample Pre-Flight Briefing

A discussion led by the PIC prior to aircraft launch which shall include but not be limited to:

- ☐ Review of mission goals and methods to achieve goals, including handoff procedures. Review of current and forecasted weather conditions and weather limitations on mission.
- ☐ Review of current Notice to Airmen (NoTAMs) and Temporary Flight Restrictions (TFRs) that have been issued for the proposed flight area.
- ☐ Identification of mission limitations and safety issues such as battery charge, GPS strength, and potential for radio interference.
- ☐ Review of proposed flight area, including maximum ceiling and floor.
- ☐ Review of communication procedures between PIC, Observer, and other ground support personnel.
- ☐ Review of emergency/contingency procedures including aircraft system failure, flight termination, divert, and lost link procedures.
- ☐ Review of required video or digital images.
- ☐ Identify radio frequencies / channels to be used.
- ☐ Execution of a pre-flight check following the approved checklist.

Appendix 4

Caroline Small sUAS Certificate of Registration


Small UAS Certificate of Registration	
Name: Caroline County, Virginia	<p>For U.S. citizens, permanent residents, and certain non-citizen U.S. corporations, this document constitutes a Certificate of Registration. For all others, this document represents a recognition of ownership.</p> <p>For all holders, for all operations other than as a model aircraft under sec. 336 of Pub. L. 112-95, additional safety authority from FAA and economic authority from DOT may be required.</p> <p>This Small UAS Certificate of Registration is not an authorization to conduct flight operations with an unmanned aircraft. Operations must be conducted in accordance with the applicable FAA requirements. The operator of the aircraft is responsible for knowing and understanding what those requirements are. For more information on flying for non-model purposes, please visit the FAA website at www.faa.gov/uas</p>  Federal Aviation Administration
Manufacturer: DJI	
Model: Phantom 4	
Serial Number: 07DJD08F	
Certificate Number: FA3PC9WFWW	
Issued: 03/10/2017 Expires: 03/10/2020	

Figure 1 - Phantom 4


Small UAS Certificate of Registration	
Name: Caroline County, Virginia	<p>For U.S. citizens, permanent residents, and certain non-citizen U.S. corporations, this document constitutes a Certificate of Registration. For all others, this document represents a recognition of ownership.</p> <p>For all holders, for all operations other than as a model aircraft under sec. 336 of Pub. L. 112-95, additional safety authority from FAA and economic authority from DOT may be required.</p> <p>This Small UAS Certificate of Registration is not an authorization to conduct flight operations with an unmanned aircraft. Operations must be conducted in accordance with the applicable FAA requirements. The operator of the aircraft is responsible for knowing and understanding what those requirements are. For more information on flying for non-model purposes, please visit the FAA website at www.faa.gov/uas</p>  Federal Aviation Administration
Manufacturer: DJI	
Model: Matrice 210	
Serial Number: 0G0DF650230021	
Certificate Number: FA34NX9H7W	
Issued: 09/13/2018 Expires: 09/13/2021	

Figure 2 - Matrice 210

Small UAS Certificate of Registration	
Name: Caroline County, Virginia	<p>For U.S. citizens, permanent residents, and certain non-citizen U.S. corporations, this document constitutes a Certificate of Registration. For all others, this document represents a recognition of ownership.</p> <p>For all holders, for all operations other than as a model aircraft under sec. 336 of Pub. L. 112-95, additional safety authority from FAA and economic authority from DOT may be required.</p> <p>This Small UAS Certificate of Registration is not an authorization to conduct flight operations with an unmanned aircraft. Operations must be conducted in accordance with the applicable FAA requirements. The operator of the aircraft is responsible for knowing and understanding what those requirements are. For more information on flying for non-model purposes, please visit the FAA website at www.faa.gov/uas</p>  Federal Aviation Administration
Manufacturer: DJI	
Model: Mavic 2 Enterprise	
Serial Number: 276DFAS0016DTJ	
Certificate Number: FA34FPH3T7	
Issued: 12/27/2018 Expires: 12/27/2021	

Figure 3 - Mavic 2 Enterprise Zoom

Appendix 5 Aircraft Specifications

Phantom 4

Specifications

Aircraft

Weight (Battery & Propellers Included)	1380 g
Max Ascent Speed	6 m/s (Sport mode)
Max Descent Speed	4 m/s (Sport mode)
Max Speed	20 m/s (Sport mode)
Max Service Ceiling Above Sea Level	19685 feet (6000 m) (Software altitude limit: 400 feet above takeoff point)
Max Flight Time	Approx. 28 minutes
Operating Temperature Range	32° to 104° F (0° to 40° C)
Satellite Systems	GPS/GLONASS

Gimbal

Controllable Range	Pitch: - 90° to + 30°
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Obstacle Sensing System

Obstacle Sensory Range	2 - 49 feet (0.7 - 15 m)
Operating Environment	Surface with clear pattern and adequate lighting (lux > 15)

Vision Positioning System

Velocity Range	≤10 m/s (2 m above ground)
Altitude Range	0 - 33 feet (0 - 10 m)
Operating Range	0 - 33 feet (0 - 10 m)
Operating Environment	Surfaces with a clear pattern and adequate lighting (lux > 15)

Camera

Sensor	1/2.3" Effective pixels:12 M
Lens	FOV (Field Of View) 94° 20 mm (35 mm format equivalent) f/2.8 focus at ∞
ISO Range	100-3200(video) 100-1600(photo)
Electronic Shutter Speed	8 s to 1/8000 s
Max Image Size	4000 x 3000

Still Photography Modes	Single shot
	Burst shooting: 3/5/7 frames
	Auto Exposure Bracketing (AEB): 3/5 Bracketed frames at 0.7EV Bias
	Time-lapse
	HDR

Video Recording Modes	UHD: 4096×2160 (4K)	24 / 25p
	3840×2160 (4K)	24 / 25 / 30p
	2704×1520 (2.7K)	24 / 25 / 30p
	FHD: 1920×1080	24 / 25 / 30 / 48 / 50 / 60 / 120p
	HD: 1280×720	24 / 25 / 30 / 48 / 50 / 60p

Max. Bitrate Of Video Storage	60 Mbps
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Supported File Systems	FAT32 (≤ 32 GB); exFAT (> 32 GB)
Photo	JPEG, DNG (RAW)
Video	MP4 / MOV (MPEG – 4 AVC / H.264)
Supported SD Cards	Micro SD, Max capacity: 64GB. Class 10 or UHS-1 rating required
Operating Temperature	32° to 104° F (0° to 40° C)
Remote Controller	
Operating Frequency	2.400 GHz to 2.483 GHz
Max Transmission Distance	FCC Compliant: 3.1 mi (5 km); CE Compliant: 2.2 mi (3.5 km) (Unobstructed, free of interference)
Operating Temperature	32° to 104° F (0° to 40° C)
Battery	6000 mAh LiPo 2S
Mobile Device Holder	Tablets and smartphones
Transmitter Power (EIRP)	FCC: 23 dBm; CE: 17 dBm
Operating Voltage	7.4V @ 1.2A
Charger	
Voltage	17.4 V
Rated Power	100 W
Intelligent Flight Battery (PH4 - 5350 mAh -15.2 V)	
Capacity	5350 mAh
Voltage	15.2 V
Battery Type	LiPo 4S
Energy	81.3 Wh
Net Weight	462 g
Operating Temperature	14° to 104° F (-10° to 40° C)
Max. Charging Power	100 W

M210 SPECIFICATIONS

AIRCRAFT

Model	M210
Package Dimensions	31.1×15.4×11.4inch (790×390×290mm)
Dimensions (unfolded)	34.9×34.6×14.9 inch (887×880×378 mm)
Dimensions (folded)	28.2×8.7×9.3 inch (716×220×236 mm)
Folding Method	Folded Inward
Diagonal Wheelbase	25.3 inch (643 mm)
Number of Batteries	2
Weight (TB50)	Approx.3.84kg (with two standard batteries)
Weight (TB55)	Approx.4.57kg (with two standard batteries)
Max Takeoff Weight	6.14KG
Max Payload (2 TB50)	Approx.2.3kg (with two standard batteries)
Max Payload (2 TB55)	Approx.1.57kg (with two standard batteries)
Hovering Accuracy (during safe flights)	Vertical: ±0.5 , Downward Vision System enabled: ±0.1
	Horizontal: ±1.5 , Downward Vision System enabled: ±0.3
Max Angular Velocity	Pitch: 300° /s ; Yaw:150° /s
Max Pitch Angle (Dual Downward Gimbals)	P Mode: 25° (Forward Vision System enabled: 25°) ; A
	Mode: 25° ; S Mode: 30°
Max Pitch Angle(Single Upward/Downward Gimbal)	P Mode: 30° (Forward Vision System enabled: 25°) ; A
	Mode: 30° ; S Mode: 35°
Max Ascent Speed	16.4 ft/s (5 m/s)
Max Descent Speed	Vertical: 9.8 ft/s (3 m/s)
	S Mode: 40.3mph (64.8kph)
Max Speed(Dual Downward Gimbals)	P Mode: 38mph (61.2kph)
	A Mode: 38mph (61.2kph)
	S Mode: 51.4mph (82.8kph)
	P Mode: 38mph (61.2kph)
Max Speed (Single Upward/Downward Gimbals)	A Mode: 51.4mph(82.8kph)
Max Service Ceiling Above Sea Level	1.86 miles (3000 m)
Max Wind Resistance	39.4 ft/s (12 m/s)
Max Flight Time(No Payload, with TB50)	27min
Max Flight Time(No Payload, with TB55)	38min
Max Flight Time(Full Payload, with TB50)	13min
Max Flight Time(Full Payload, with TB55)	24min
Motor Model	DJI 3515
Propeller Model	1760S
Operating Temperature	-4° to 113° F (-20° to 45° C)
IP Rating	IP43

GIMBAL INSTALLATION

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Downward Gimbal Mount Supported
Upward Gimbal Mount Supported
Downward Dual Gimbal Supported

CHARGER

Model IN2C180
Voltage 26.1 V
Rated Power 180 W

FORWARD VISION SYSTEM

Obstacle Sensing Range 2.3-98.4 feet (0.7-30 m)
FOV Horizontal 60° , Vertical 54°
Operating Environment Surfaces with clear patterns and adequate lighting (> 15 lux)

DOWNWARD VISION SYSTEM

Velocity Range	<32.8 ft/s (10 m/s) at height of 6.56 feet (2 m)
Altitude Range	<32.8 feet (10 m)
Operating Range	<32.8 feet (10 m)
Operating Environment	Surfaces with clear patterns and adequate lighting (> 15 lux)
Ultrasonic Sensor Operating Range	0.33-16.4 feet (10-500 cm)
Ultrasonic Sensor Operating Environment	Non-absorbing material, rigid surface (thick indoor carpeting will reduce performance)

GIMBALS

	Zenmuse X4S
	Zenmuse X5S
	Zenmuse Z30
Compatible Gimbals	Zenmuse XT
	Zenmuse XT2
	SLANTRANGE 3PX
	Sentera AGX710

BATTERY

Model	TB50
Capacity	4280 mAh
Voltage	22.8V
Battery Type	LiPo 6S
Energy	97.58 Wh
Net Weight	Approx. 520 g
Operating Temperature	-20°C to 45° C
Storage Temperature	Storage Temperature Less than 3 months: -4° to 113° F (-20° to 45° C) More than 3 months: 72° to 82° F (22° to 28° C)
Charging Temperature	41° to 104° F (5° to 40° C)
Max Charging Power	180 W

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Model	TB55
Capacity	7660 mAh
Voltage	22.8V
Battery Type	LiPo 6S
Energy	176.93Wh
Net Weight	Approx. 885 g
Operating Temperature	-4° to 113° F (-20° to 45° C)
Storage Temperature	Less than 3 months: -20° C to 45° C More than 3 months: 22° C to 28° C
Charging Temperature	41° to 104° F (5° to 40° C)
Max Charging Power	180 W

DJI GO 4 APP

Name	DJI GO 4
Mobile Device	
System	iOS 9.0 or later, Android 4.4.0 or later
Requirements	iOS: iPhone 5s, iPhone SE, iPhone 6, iPhone 6 Plus, iPhone 6s, iPhone 6s Plus, iPhone 7, iPhone 7 Plus, iPad Air, iPad Air Wi-Fi + Cellular, iPad mini 2, iPad mini 2 Wi-Fi + Cellular, iPad Air 2, iPad Air 2 Wi-Fi + Cellular, iPad mini 3, iPad mini 3 Wi-Fi + Cellular, iPad mini 4 and iPad mini 4 Wi-Fi + Cellular. This app is optimized for iPhone 7, iPhone 7 Plus. Android: Samsung tabs 705c, Samsung S6, Samsung S5, Samsung NOTE4, Samsung NOTE3, Google Nexus 6p, Nexus 9, Google Nexus 7 II, Ascend Mate7, Huawei P8 Max, Huawei Mate 8, LG V20, Nubia Z7 mini, Sony Xperia Z3, MI 3, MI PAD, Smartisan T1.
Supported Mobile Devices	

*Support for additional devices available as testing and development continues.

UPWARD INFRARED SENSOR

Obstacle Sensing Range	0-16.4 feet (0-5 m)
FOV	±5°
Operating Environment	Large, diffuse and reflective obstacles (reflectivity >10%)

CENDENCE

Type	GL800A
Operating Frequency	2.400-2.483 GHz; 5.725-5.825 GHz 2.4 GHz: 4.3 miles (7 km, FCC); 2.2 miles (3.5 km, CE); 2.5 miles (4 km, SRRC) 5.8 GHz: 4.3 miles (7 km, FCC); 1.2 miles (2 km, CE); 3.1 miles (5 km, SRRC)
Max Transmitting Distance (unobstructed, free of interference)	2.4 GHz: 26 dBm (FCC); 17 dBm (CE); 20 dBm (SRRC) 5.8 GHz: 28 dBm (FCC); 14 dBm (CE); 20 dBm (SRRC)
EIRP	
Power Supply	Extended Intelligent Battery (Model: WB37-4920mAh-7.6V)
Intelligent Battery	4923 mAh LiPo
Charging	DJI charger
Output Power	20 W (supplying power to DJI CS550 monitor) 12 W (without supplying power to monitor)
Video Output Ports	USB, HDMI, SDI

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USB Supply Power	iOS: 1 A, 5.2 V (Max); Android: 1.5 A, 5.2 V (Max)
Dual User Capability	Master-and-Slave connection
Operating Temperature	-4 ° to 104 °F (-20 ° to 40 °C)
Storage Temperature	Less than 3 months: -4 ° to 113 °F (-20 °to 45 °C) More than 3 months: 72 °to 82 °F (22 °to 28 °C)
Charging Temperature	32 ° to 104 °F (0 °to 40 °C)
Charging Time	About 2 hours and 24 minutes (using a 180 W charger)
Supply Power Time	About 4 hours (only Master remote controller function enabled and without supplying power to monitor)
Weight	1041 g

Zenmuse Z30 Specifications

GENERAL

Name Zenmuse Z30
Dimensions 152×137×61 mm
Weight 556 g

CAMERA

Sensor	CMOS, 1/2.8" Effective Pixels: 2.13 M 30x Optical Zoom F1.6 (Wide) - F4.7 (Tele) Zoom Movement Speed:
Lens	- Optical Wide – Optical Tele: 4.6 sec - Optical Wide – Digital Tele: 6.4 sec - Digital Wide – Digital Tele : 1.8 sec Focus Movement Time: ∞ - near: 1.1 sec
FOV	63.7°(Wide) - 2.3°(Tele)
Digital Zoom	6x
Min. Working Distance	10 mm - 1200 mm
Photo Formats	JPEG
Video Formats	MOV, MP4
Working Modes	Capture, Record, Playback
Still Photography Modes	Single shot, Burst shooting: 3/5 frames, Interval (2/3/4/7/10/15/20/30 sec)
Exposure Mode	Exposure Mode Auto, Manual, Shutter priority, Aperture priority
Exposure Compensation	± 2.3 (1/3 increments)
Metering Mode	Center-weighted metering, Spot metering (Area option 12x8)
AE Lock	Supported
Electronic Shutter Speed	1/30 – 1/6000 s
White Balance	Auto, Sunny, Cloudy, Incandescent, Custom (2000K - 10000K)
Video Captions	Supported
TapZoom	Supported
TapZoom Range	1-5
Defog	Supported
One Key to 1x Image	Supported
Anti-flicker	50 Hz, 60 Hz
PAL/NTSC	Supported
Supported SD Cards	MicroSD (SD / SDHC / SDXC) Max. Capacity: 64 GB, Class 10 or UHS-1
Supported File Systems	FAT32 (≤ 32 GB) exFAT (> 32 GB)

GIMBAL

Angular Vibration Range $\pm 0.01^\circ$
Mount Detachable
Controllable Range Pitch : $+40^\circ$ to -90° , Yaw: $\pm 320^\circ$
Mechanical Range Pitch : $+50^\circ$ to -140° , Yaw: $\pm 330^\circ$, Roll: $+90^\circ$ to -50°
Max Controllable Speed Pitch : $180^\circ/\text{s}$, Yaw: $180^\circ/\text{s}$

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ENVIRONMENTAL

Operating Temperature 14° to 113° F (-10° to 45° C)

Non-Operating Temperature -4° to 140° F (-20° to 60° C)

Zenmuse XT2 Specifications

GENERAL

Name	Zenmuse XT2
Dimensions	With 25 mm lens: 123.7×112.6×127.1 mm
	With other lens: 118.02×111.6×125.5 mm

THERMAL CAMERA

Thermal Imager	Uncooled VOx Microbolometer
FPA/Digital Video Display Formats	640×512
	336×256
Digital Zoom	640×512: 1x, 2x, 4x, 8x
	336×256: 1x, 2x, 4x
Pixel Pitch	17 μm
Spectral Band	7.5-13.5 μm
Full Frame Rates	30 Hz
Exportable Frame Rates	<9 Hz
Sensitivity (NEΔT)	<50 mk @ f/1.0
Scene Range (High Gain)	640×512: -25° to 135°C
	336×256: -25° to 100°C
Scene Range (Low Gain)	-40° to 550°C
File Storage	MicroSD card*
Photo Format	JPEG, TIFF, R-JPEG
Video Format	8 bit: MOV, MP4 14 bit: TIFF Sequence, SEQ**

IMAGE PROCESSING & DISPLAY CONTROL

Image Optimization	Yes
Digital Detail Enhancement	Yes
Polarity Control (Black Hot/ White Hot)	Yes

GIMBAL

Angular Vibration Range	±0.01°
Mount	Detachable
Controllable Range	Tilt: +30° to -90°
	Pan: ±320°
Mechanical Range	Tilt: +45° to -130°
	Pan: ±330°
	Roll: -90° to +60°
Max Controllable Speed	Tilt: 90°/s
	Pan: 90°/s

VISUAL CAMERA

Sensor	1/1.7" CMOS
	Effective Pixels: 12 M
Lens	Prime lens
	Focus at 8 mm
	FOV 57.12°× 42.44°
Digital Zoom	1x, 2x, 4x, 8x

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Photo Formats	JPEG
Video Formats	MOV, MP4
Video Resolutions	4K Ultra HD: 3840×2160 29.97p FHD: 1920×1080 29.97p
Working Modes	Capture, Record, Playback Single Shot
Still Photography Modes	Burst Shooting(3/5 frames) Interval (2/3/4/7/10/15/20/30 sec)
Video Caption	Supported
Anti-flicker	Auto, 50 Hz, 60 Hz
Storage	MicroSD card Max capacity: 128 GB. UHS-3 required Recommended model: Sandisk Extreme 16/32 GB UHS-3 microSDHC Sandisk Extreme 64/128 GB UHS-3 microSDXC
Supported File System	FAT 32 (≤32GB), exFAT (>32GB)

IMAGE PROCESSING & DISPLAY CONTROL

Color & Monochrome Palettes (LUT)Yes

MODELS – LENS AND RESOLUTION OPTIONS

Thermal Lens Models	9 mm, 13 mm, 19 mm, 25 mm
640×512 FoV, iFoV	N/A, f/1.25 45°×37° 1.308 mr, f/1.25 32°×26° 0.895 mr, f/1.1 25°×20° 0.680 mr
336×256 FoV, iFoV	f/1.25 35°×27° 1.889 mr, f/1.25 25°×19° 1.308 mr, f/1.25 17°×13° 0.895 mr, N/A
Min Focus Distance	3.2 cm, 7.6 cm, 15.3 cm, 30 cm
Hyperfocal Distance	2.1 m, 4.4 m, 9.5 m, 21m
Hyperfocal Depth of Field	1.1 m, 2.2 m, 4.8 m, 11m
Notes	The SD card, which is located near the lens, is used to store TIFF Sequence and SEQ infrared RAW video only. The other format footage will be stored in the other SD card. *It is recommended to use ImageJ to play the TIFF Sequence video and Flir Tools to play SEQ video

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DJI Mavic 2 Enterprise Zoom Specifications

AIRCRAFT

Takeoff Weight(Without Accessories)	Zoom Edition:905 g Dual Edition:899 g
	Folded : 214×91×84 mm Unfolded: 322×242×84 mm
Dimensions(L×W×H)	Unfolded+Spotlight : 322×242×114 mm Unfolded+Beacon : 322×242×101 mm Unfolded+Speaker : 322×242×140 mm
Diagonal Length	354 mm
Max Ascent Speed	5 m/s (S-mode ⁽¹⁾) 4 m/s (P-mode) 4 m/s (S-mode with accessories ⁽¹⁾) 4 m/s (P-mode with accessories)
Max Descent Speed	3 m/s (S-mode ⁽¹⁾) 3 m/s (P-mode)
Max Speed (near sea level, no wind)	72 kph (S-mode , without wind) 50 kph (P-mode , without wind)
Max Service Ceiling Above Sea Level	6000 m
Max Flight Time (no wind)	31 min (at a consistent speed of 25 kph) 29 min 27 min (with beacon turned on) 28 min (with beacon turned off)
Max Hovering Time (no wind)	22 min (with spotlight turned on) 26 min (with spotlight turned off) 25 min (with speaker turned on) 26 min (with speaker turned off)
Max Wind Speed Resistance	29–38 kph
Max Tilt Angle	35° (S-mode, with remote controller) 25° (P-mode) 200°/s (S-Mode)
Max Angular Velocity	100°/s (P-Mode) 200°/s (S-Mode) 100°/s (P-Mode)
Operating Temperature Range	-10°C to 40°C
GNSS	GPS+GLONASS Vertical: ±0.1 m (with Vision Positioning)
Hovering Accuracy Range	±0.5 m (with GPS Positioning) Horizontal: ±0.3m (with Vision Positioning) ±1.5 m (with GPS Positioning)
Operating Frequency	2.400 - 2.4835 GHz 5.725 - 5.850 GHz
Transmission Power (EIRP)	2.400 - 2.4835 GHz FCC : ≤26 dBm

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	CE : ≤ 20 dBm
	SRRC : ≤ 20 dBm
	MIC : ≤ 20 dBm 5.725-5.850 GHz
	FCC : ≤ 26 dBm
	CE : ≤ 14 dBm
	SRRC : ≤ 26 dBm
Internal Storage	24 GB

GIMBAL

Mechanical Range	Tilt: $-135 - +45^{\circ}$ Pan: $-100 - +100^{\circ}$
Controllable Range	Tilt: $-90 - +30^{\circ}$ Pan: $-75 - +75^{\circ}$
Stabilization	3-axis (tilt, roll, pan)
Max Control Speed (tilt)	$120^{\circ}/s$
Angular Vibration Range	$\pm 0.005^{\circ}$

SENSING SYSTEM

Sensing System	Omnidirectional Obstacle Sensing [3] Precision Measurement Range: 0.5 - 20 m
Forward	Detectable Range: 20 - 40 m Effective Sensing Speed: $\leq 14m/s$ FOV: Horizontal: 40° , Vertical: 70° Precision Measurement Range: 0.5 - 16 m
Backward	Detectable Range: 16 - 32 m Effective Sensing Speed: $\leq 12m/s$ FOV: Horizontal: 60° , Vertical: 77°
Upward	Precision Measurement Range: 0.1 - 8 m
Downward	Precision Measurement Range: 0.5 - 11 m Detectable Range: 11 - 22 m
Sides	Precision Measurement Range: 0.5 - 10 m Effective Sensing Speed: $\leq 8m/s$ FOV: Horizontal: 80° , Vertical: 65° Forward, Backward and Sides: Surface with clear pattern and adequate lighting (lux > 15) Upward: Detects diffuse reflective surfaces (>20%)
Operating Environment	(walls, trees, people, etc.) Downward: Surface with clear pattern and adequate lighting (lux > 15) Detects diffuse reflective surfaces (>20%) (walls, trees, people, etc.)

REMOTE CONTROLLER

Operating Frequency	2.400 - 2.483 GHz; 5.725 - 5.850 GHz
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Max Transmission Distance(Unobstructed, free of interference)	2.400 - 2.483 GHz; 5.725 - 5.850 GHz FCC: 8000 m CE: 5000 m SRRC: 5000 m MIC: 5000 m
Operating Temperature Range	0°C to 40°C 2.4 - 2.4835 GHz FCC : ≤26 dBm ; CE : ≤20 dBm ; SRRC : ≤20 dBm MIC : ≤20 dBm
Transmitter Power(EIRP)	5.725 - 5.850 GHz FCC : ≤26 dBm ; CE : ≤14 dBm ; SRRC : ≤26 dBm
Battery	3950mAh
Charging Time	2 hours 15 min
Operating Current/Voltage	1800mA = 3.83V
Mobile Device Holder	Thickness Supported:6.5-8.5 mm , Max length: 160 mm
RC Size	Folded : 145×80×48 mm (L×W×H) Unfolded: 190×115×100 mm (L×W×H)
Supported USB port types	Lightning, Micro USB (Type-B), USB Type-C™

M2ED VISUAL CAMERA

Sensor	1/2.3" CMOS; Effective pixels: 12M FOV: approx. 85°
Lens	35 mm format equivalent:24 mm Aperture: f/2.8 Focus: 0.5 m to ∞
ISO Range	Video: 100-3200 (auto) Photo: 100-1600 (auto)
Max Image Size	4056×3040 (4:3) ; 4056×2280 (16:9) Single shot
Still Photography Modes	Burst shooting: 3/5/7 frames Interval (2/3/5/7/10/15/20/30/60 s) 4K Ultra HD : 3840×2160 30p
Video Recording Modes	2.7K : 2688×1512 30p FHD : 1920×1080 30p
Max Video Bitrate	100 Mbps
Photo	JPEG
Video Format	MP4 , MOV (MPEG-4 AVC/H.264)

M2E CAMERA

Sensor	1/2.3" CMOS ; Effective pixels:12 Megapixels
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Lens	FOV : 82.6°(24 mm) ; 47.8°(48 mm)
	Format equivalent : 24-48 mm
	Aperture : f/2.8(24 mm)-f/3.8(48 mm)
	Auto focus at : 0.5 - ∞
ISO Range	Video :
	100-3200
	Photo :
Shutter Speed	100-1600(Auto)
	100-3200(Manual)
Still Image Size	8-1/8000s
Still Photography Modes	4000×3000
	Single shot
	Burst shooting: 3/5/7 frames
	Auto Exposure Bracketing (AEB): 3/5 bracketed frames at 0.7 EV Bias
Video Resolution	Interval (JPEG: 2/3/5/7/10/15/20/30/60s RAW:5/7/10/15/20/30/60s)
	4K: 3840×2160 24/25/30p
	2.7K: 2720×1530 24/25/30/48/50/60p
Max Video Bitrate	FHD: 1920×1080 24/25/30/48/50/60/120p
Color Mode	100 Mbps
Supported File System	D-Cinelike
Photo Format	FAT32(\leq 32 GB) ; exFAT($>$ 32 GB)
Video Format	MP4 / MOV (MPEG-4 AVC/H.264)

CHARGER

Input	100-240V , 50-60Hz , 1.8A
Output	Main: 17.6V = 3.41A or 17.0V=3.53
	USB: 5 V = 2 A
Voltage	17.6±0.1V
Rated Power	60W

INTELLIGENT FLIGHT BATTERY

Capacity	3850 mAh
Voltage	15.4 V
Max Charging Voltage	17.6 V
Battery Type	LiPo
Energy	59.29 Wh
Net Weight	297 g
Charging Temperature	5°C - 40°C
Operating Temperature	Range-10°C to 40°C
Heating Methods	Manual Heating ; Auto Heating
Heating Temperature	-20°C to 6°C
Heating duration:	500s (Max)
Heating Power	55W (Max)
Charging Time	90 min

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Max Charging Power 80W

APP / LIVE VIEW

Video Transmission System OcuSync 2.0
Mobile App DJI PILOT
Live View Quality Remote Controller:
720p@30fps / 1080p@30fps
Max Live View Bitrate 40 Mbps
Latency 120 - 130 ms
Required Operating Systems iOS 10.0 or later Android 5.0 or later

SUPPORTED SD CARDS

Supported SD Cards Micro SD™
Supporting Micro SD with capacity up to 128 GB and R/W speed up to UHS-I
Speed Grade 3

M2E SPOTLIGHT

Dimensions 68x60x41 mm
Port Type USB Micro-B
Operating Range 30 m
Power Max 26W
Illuminance FOV 17°, Max : 11lux @ 30m Straight

M2E BEACON

Dimensions 68x40x27.8 mm
Port Type USB Micro-B
Power Avg. 1.6W
Controllable Range 5000 m
Light intensity Min Angle : 55 cd ;
Light intensity Light intensity : 157 cd

M2E SPEAKER

Dimensions 68x55x65 mm
Port Type USB Micro-B
Power Max 10W
Decibel 100 db @ 1 meter distance
Bitrate 16 kbps

FOOTNOTES

- [1] Remote controller required.
- Footnotes
- [2] Due to real-time digital enhancements, the photo and video size of the thermal data is

larger than the sensor's native resolution.

[3] Omnidirectional Obstacle Sensing includes left/right, up/down, and forward/backward obstacle sensing. Sensing for left/right directions is only available in ActiveTrack or Tripod Mode. Omnidirectional Obstacle Sensing does not fully cover the circumference of a 360-degree arc. And left and right obstacle sensing system only works in specific modes and environments. DJI warranty does not cover any loss caused by crashing when flying left or right, even when ActiveTrack or Tripod mode is activated. Please be aware of your surroundings and App notifications when operating the Mavic 2 to ensure safety. These specs have been determined through tests conducted with the latest firmware. Firmware updates can enhance performance, so updating to the latest firmware is highly recommended."

[4]These specs have been determined through tests conducted with the latest firmware. Firmware updates can enhance performance, so updating to the latest firmware is highly recommended."

Appendix 6

Caroline County FAA COA

Caroline County was issued a Certificate of Waiver or Authorization (COA) on July 18, 2017 from the FAA.

This certificate, 2017-ESA-122, is effective from July 18, 2017 through July 17, 2019.

It is on file, along with any addendums, at the Department of Fire – Rescue and Emergency Management.

Appendix 7 – Sample Property Owner Letter



County of Caroline
Department of Fire-Rescue & Emergency Management

Appendix 7

DATE _____

Dear _____ Rd Resident:

Caroline County has developed an unmanned aerial vehicle (UAV) {drone} program to assist emergency services with search and rescue, damage assessment, and other emergency activities. The _____ has granted our agency access to their property to conduct a training exercise this _____ over _____. During this exercise we will simulate _____ and testing our UAV operators' ability to _____. Weather permitting our training drill will take place starting at TIME and should last a couple of hours.

We are reaching out to nearby residents to advise them of this activity so they will not be alarmed if they see a higher volume of emergency vehicles in the vicinity of the _____. Additionally, I do not want residents to be alarmed if they see or hear the drone flying over the area. The drone is relatively quiet, however, if you are outside it may sound like a distant swarm of bees. The Department is very mindful of your privacy and will work to keep overflights of your property to a minimum.

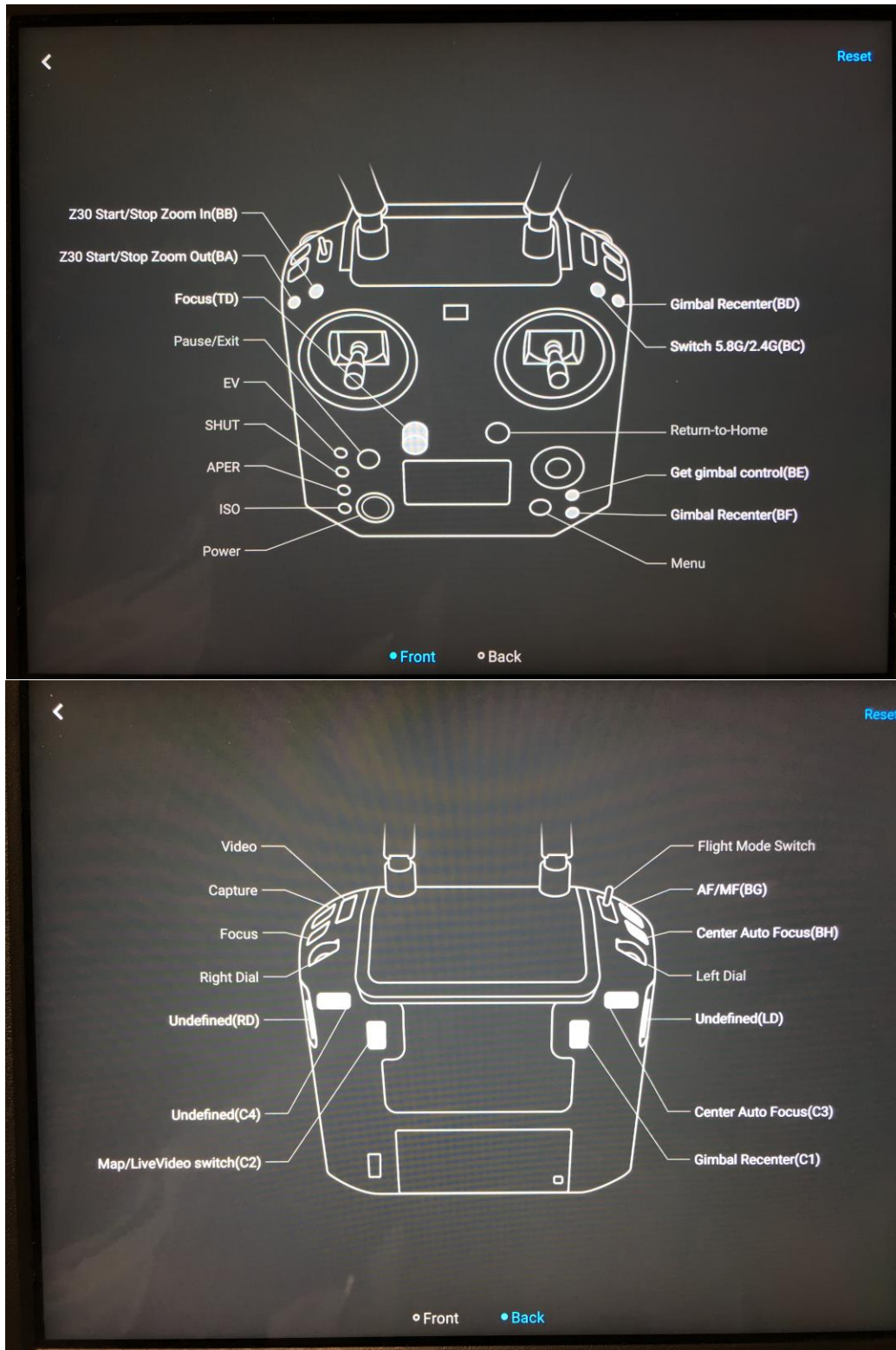
Thank you for your understanding as we hone our training skills with this new technology. Please feel free to call us at 804-633-9831 if you have any questions or concerns.

Sincerely,

Mark C. Garnett
Deputy Fire – EMS Chief

233 West Broadus Ave. • Bowling Green, VA 22427
Phone: 804-633-9831 • Fax: 804-633-9832

Appendix 8 – Cendence Remote – Custom Settings Chart



*Appendix 9 – Time Conversion Chart***Chart To Convert Minutes To Tenths Of An Hour**

Minutes to be reported	Tenth of Hour reported	Minutes to be reported	Tenth of Hour reported	Minutes to be reported	Tenth of Hour reported
1 min.	0.0	21 min.	0.4	41 min.	0.7
2 min.	0.0	22 min.	0.4	42 min.	0.7
3 min.	0.1	23 min.	0.4	43 min.	0.7
4 min.	0.1	24 min.	0.4	44 min.	0.7
5 min.	0.1	25 min.	0.4	45 min.	0.8
6 min.	0.1	26 min.	0.4	46 min.	0.8
7 min.	0.1	27 min.	0.5	47 min.	0.8
8 min.	0.1	28 min.	0.5	48 min.	0.8
9 min.	0.2	29 min.	0.5	49 min.	0.8
10 min.	0.2	30 min.	0.5	50 min.	0.8
11 min.	0.2	31 min.	0.5	51 min.	0.9
12 min.	0.2	32 min.	0.5	52 min.	0.9
13 min.	0.2	33 min.	0.6	53 min.	0.9
14 min.	0.2	34 min.	0.6	54 min.	0.9
15 min.	0.3	35 min.	0.6	55 min.	0.9
16 min.	0.3	36 min.	0.6	56 min.	0.9
17 min.	0.3	37 min.	0.6	57 min.	1.0
18 min.	0.3	38 min.	0.6	58 min.	1.0
19 min.	0.3	39 min.	0.7	59 min.	1.0
20 min.	0.3	40 min.	0.7	60 min.	1.0